

EUV Actinic Blank Inspection Tool Development

EUVL Symposium 2012

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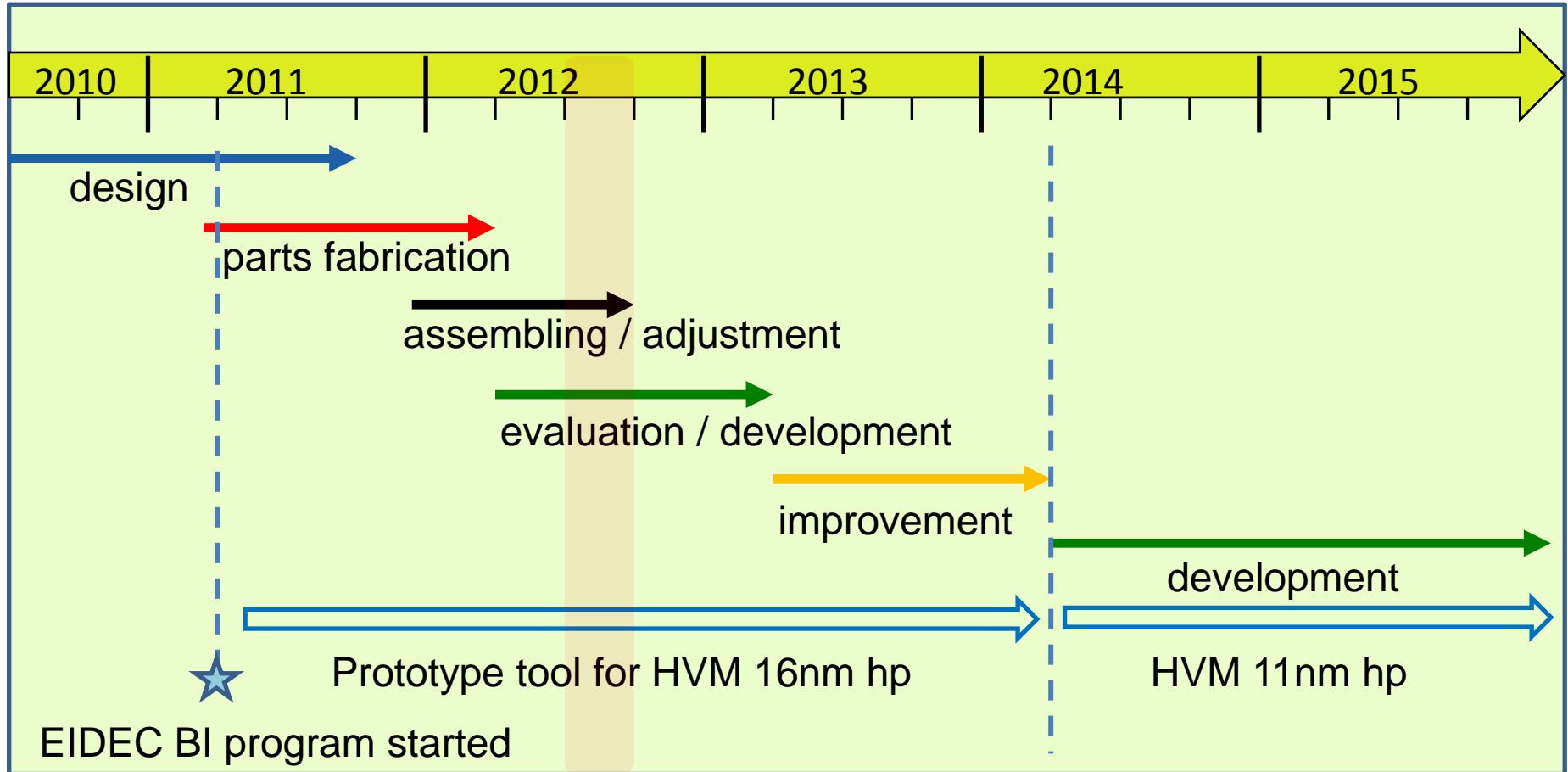
1. Introduction
2. Illumination efficiency improvement
3. Solutions to use a new EUV filter
4. High magnification review optics
5. Summary

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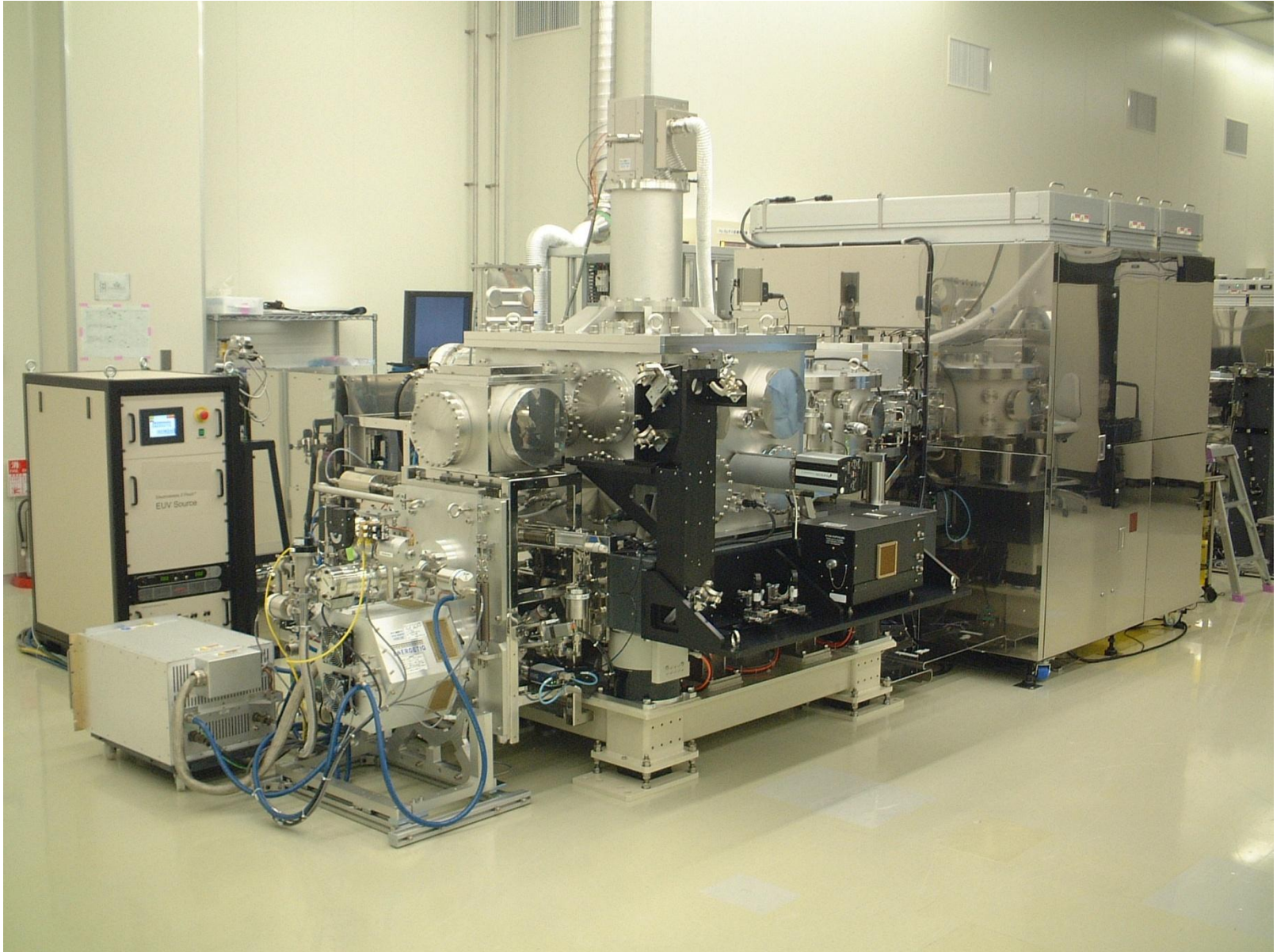
ABI HVM Tool Development Schedule

EIDEC – Lasertec Blank Inspection Project

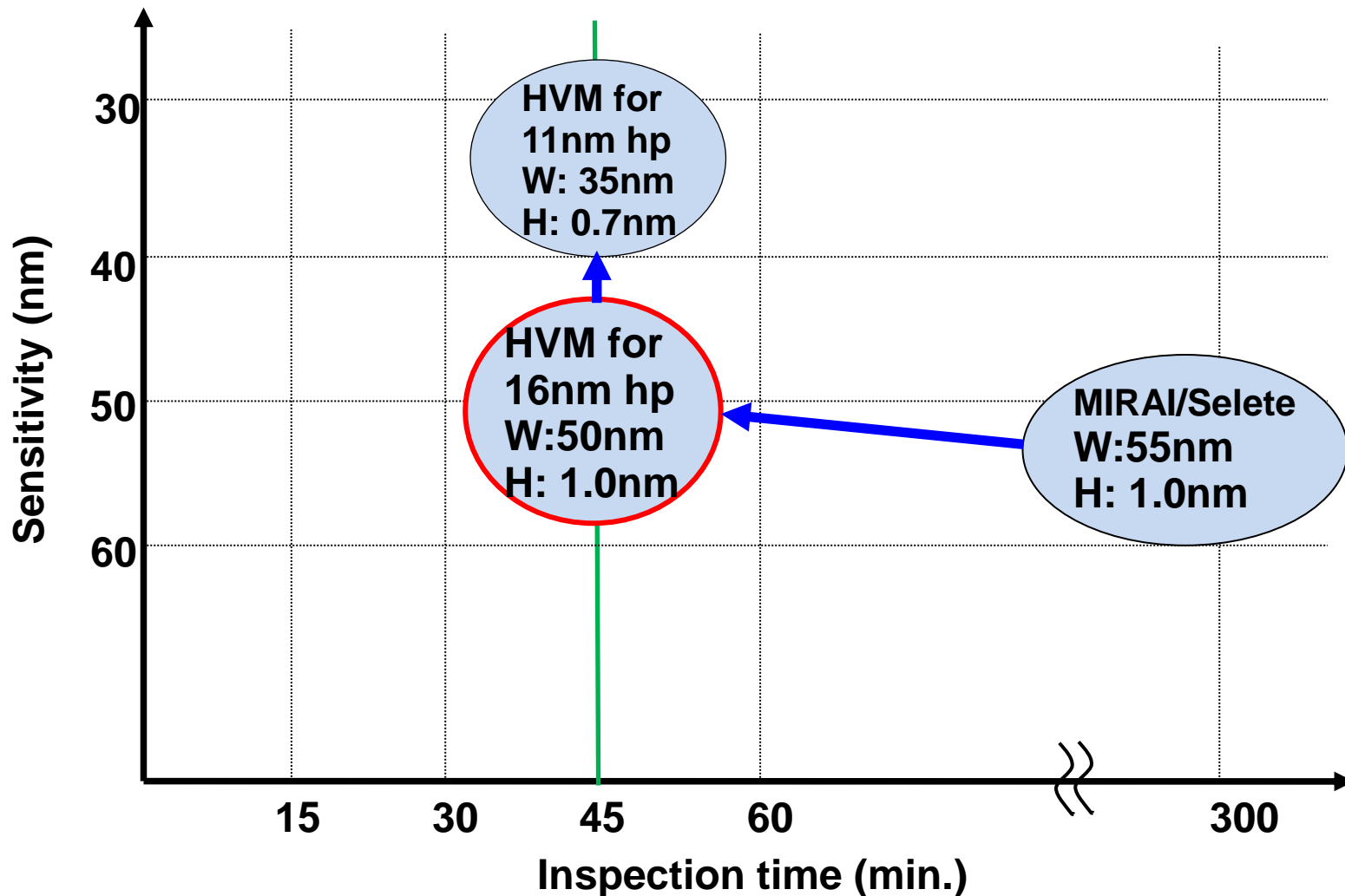


- Assembly of the ABI HVM tool has been completed.
- Adjustment and evaluation are in progress on schedule.

ABI HVM Tool

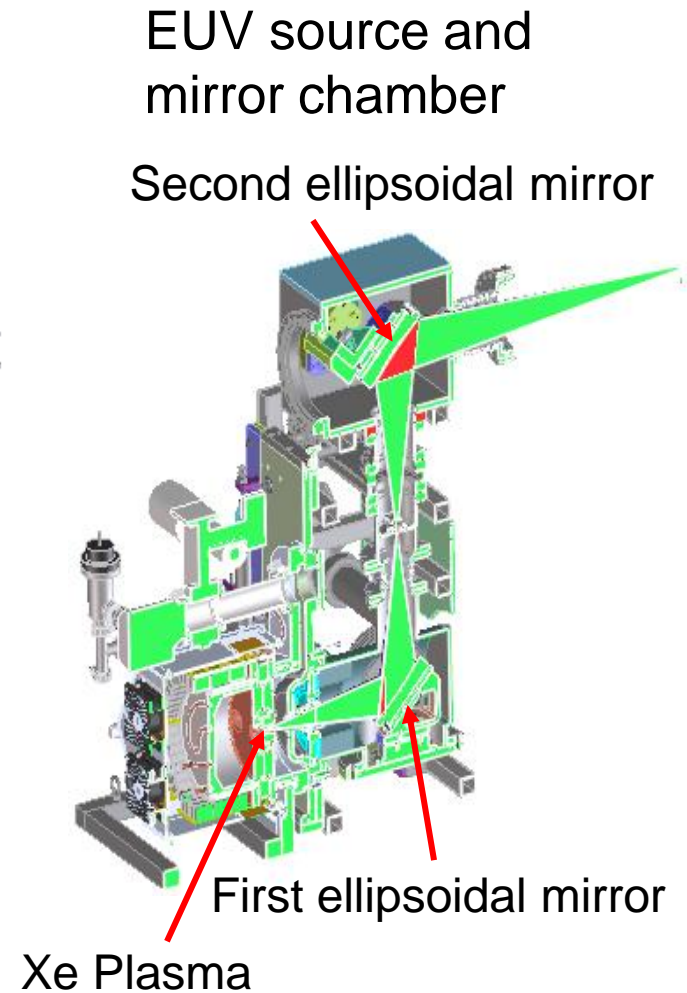
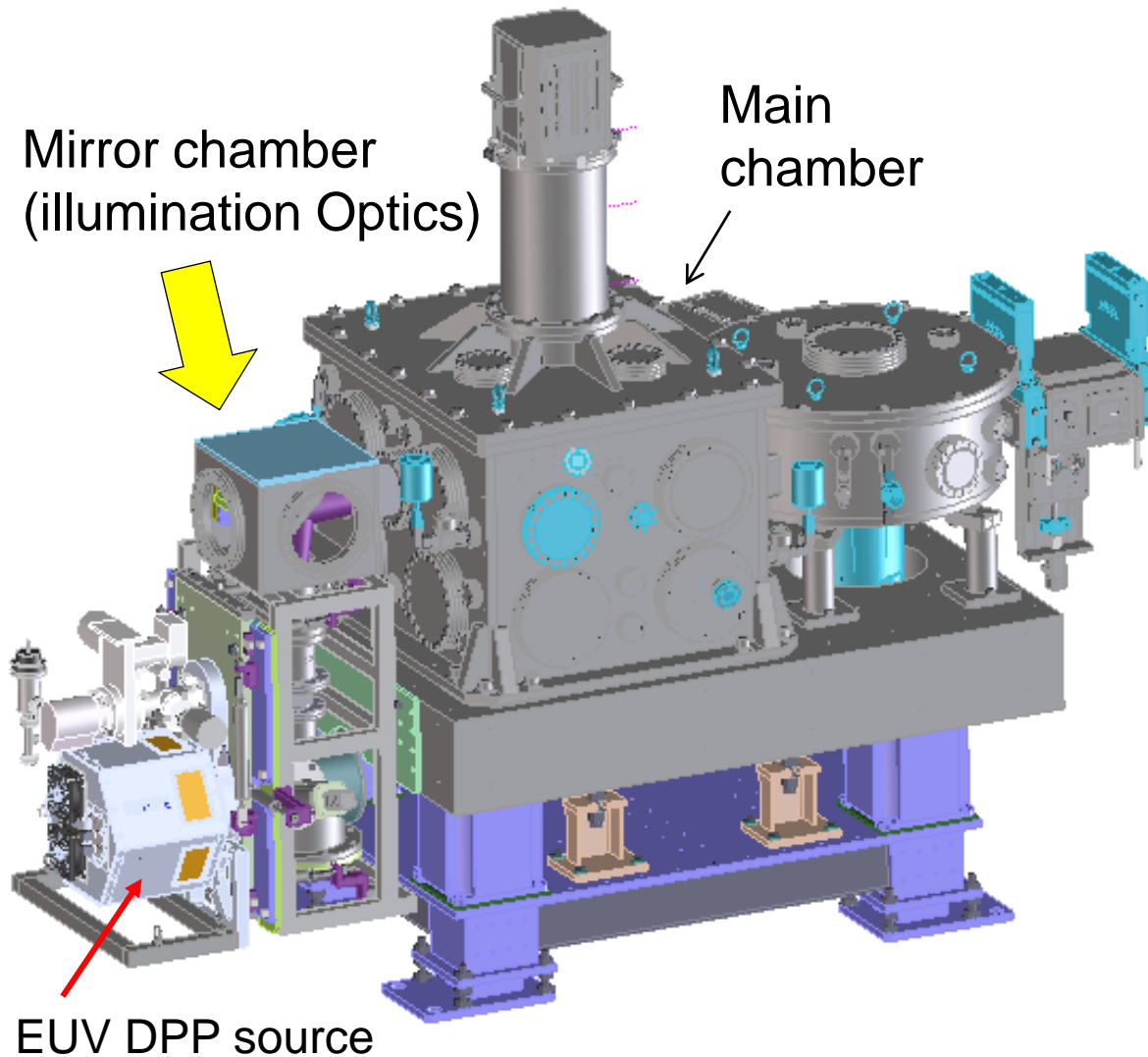


Actinic mask blank inspection sensitivity roadmap



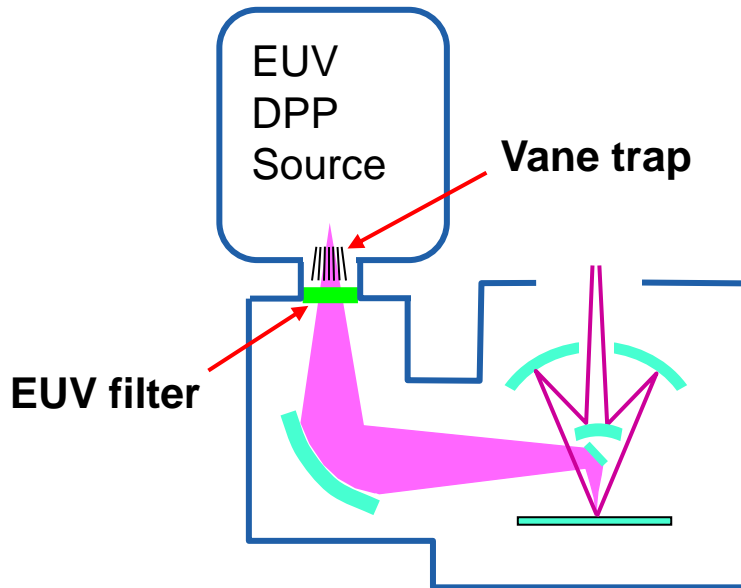
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Illumination optics of the ABI tool

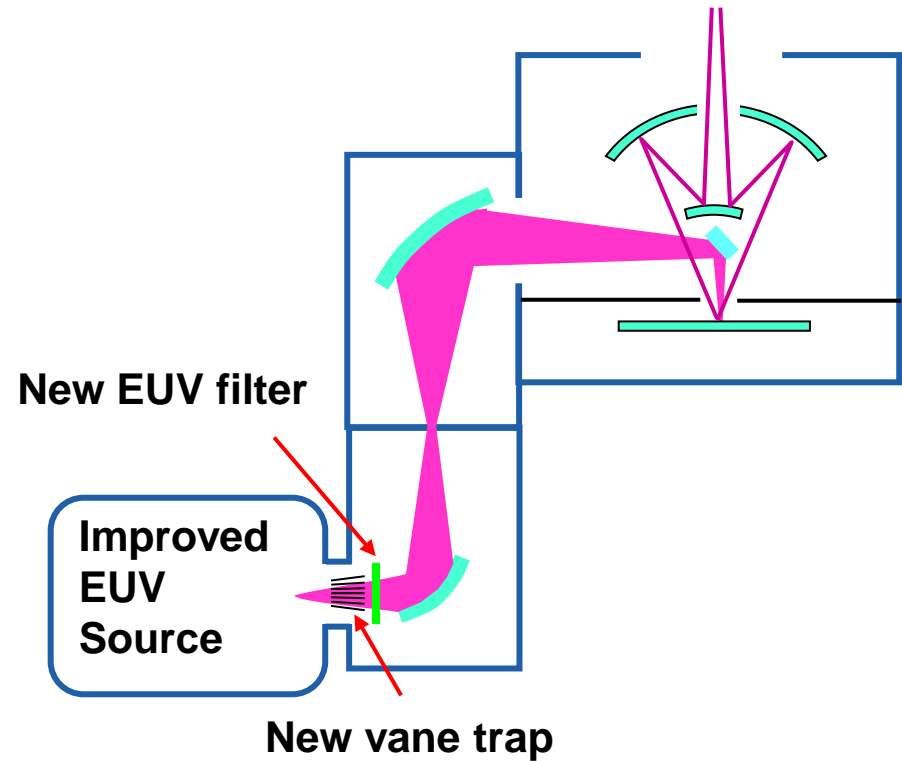


Illumination optics for the HVM tool

1. Previous design



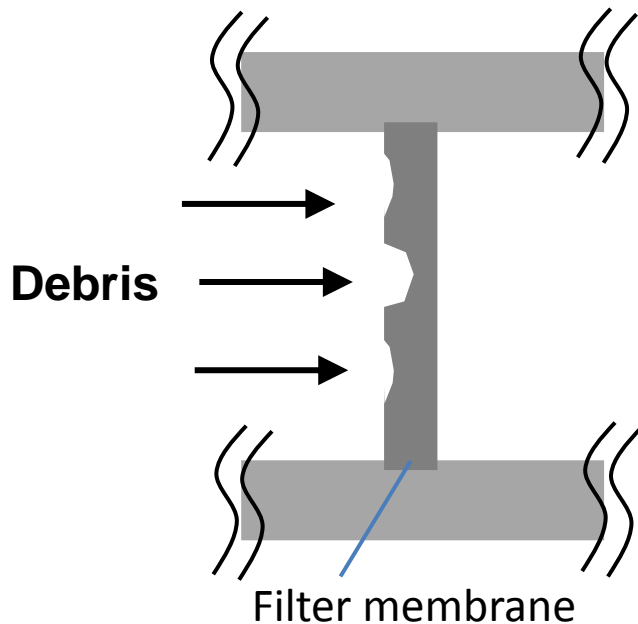
2. HVM design



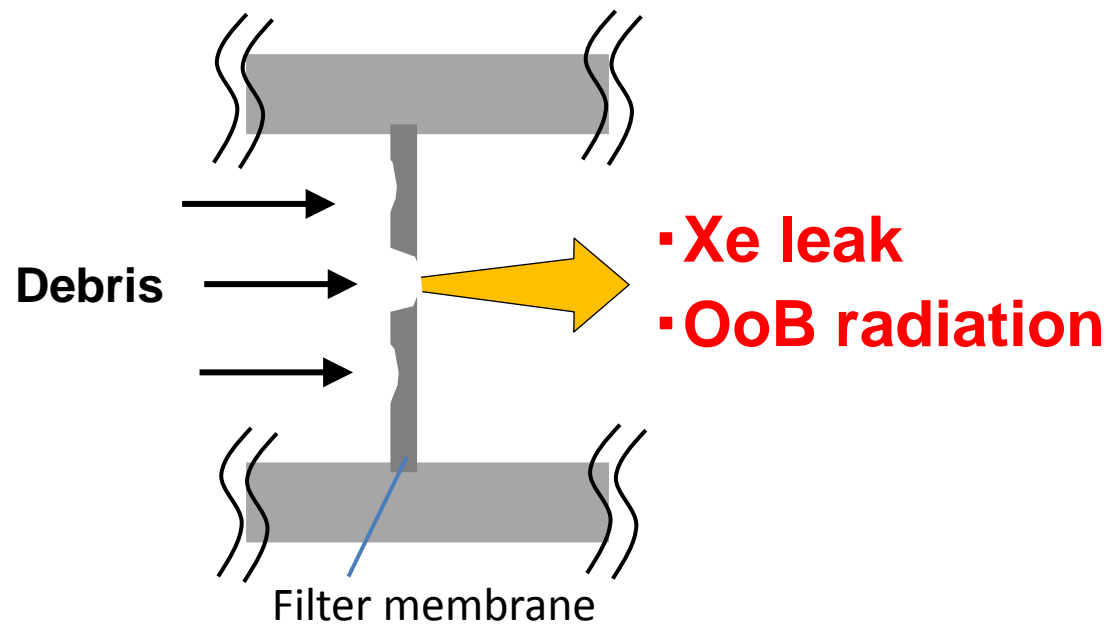
Two times higher transmission can be expected by improving the EUV filter and the vane trap

Anticipated problems using a new EUV filter

Previous design

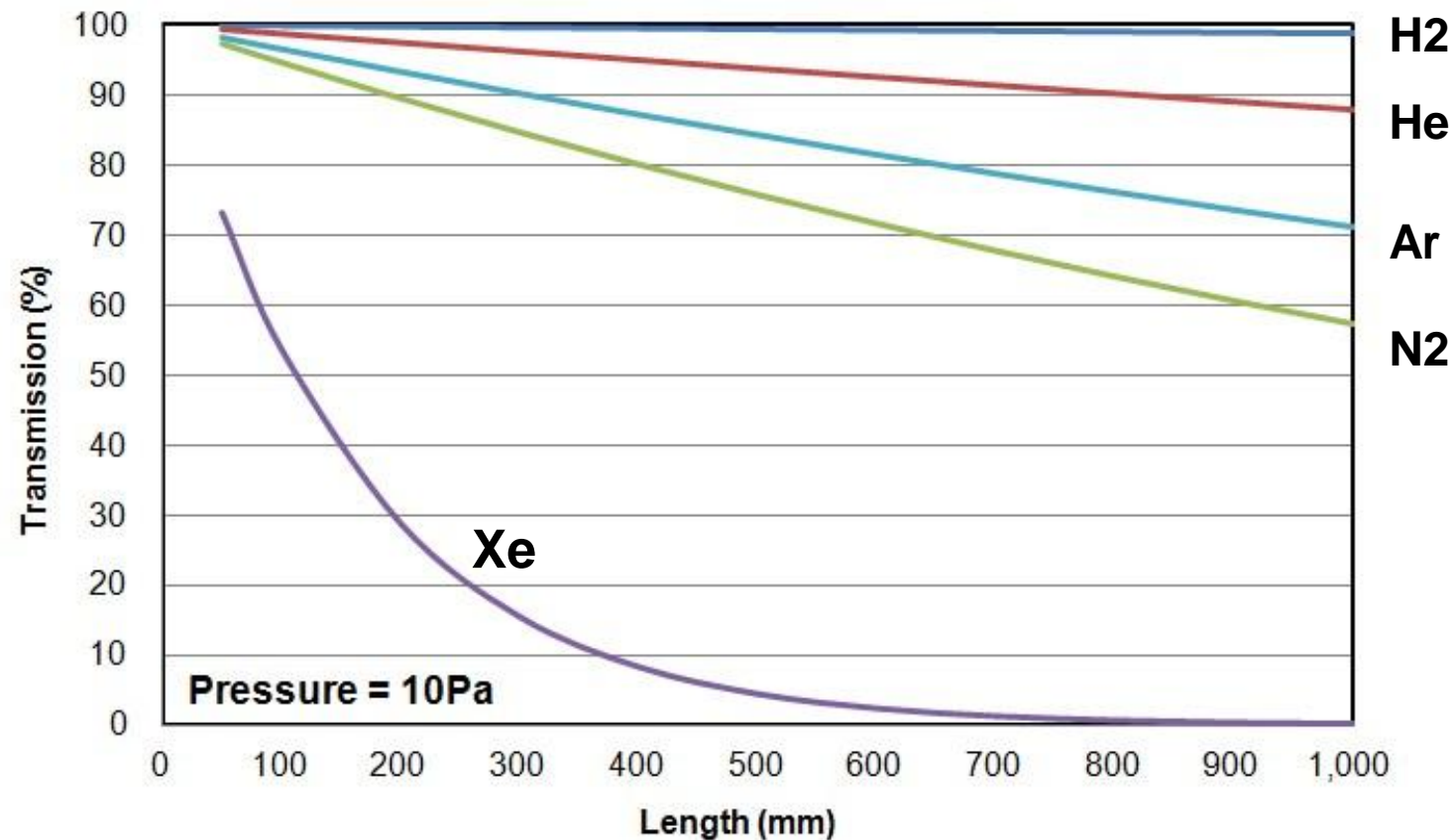


HVM design



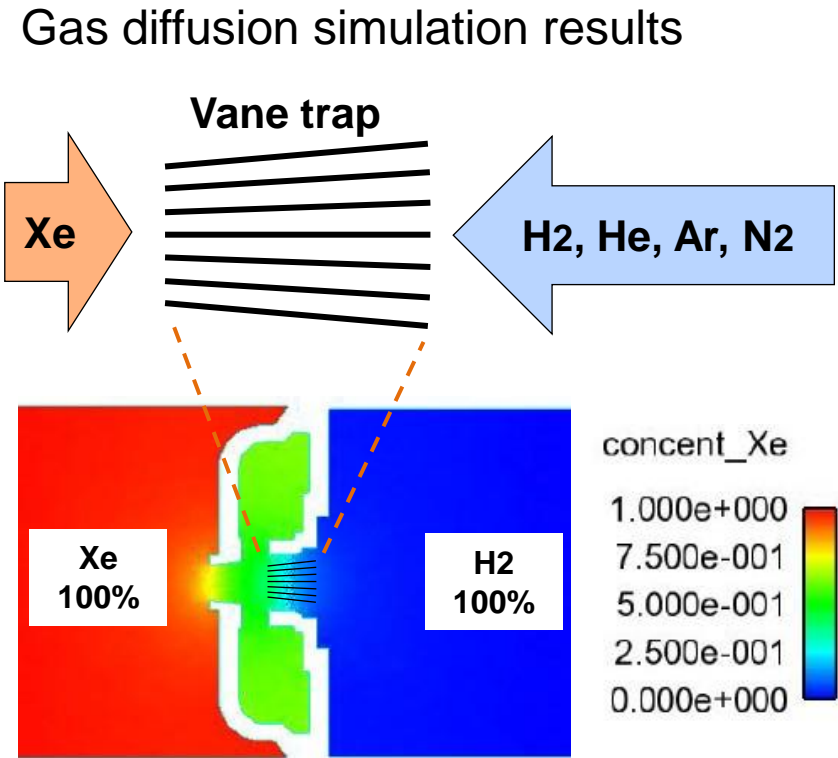
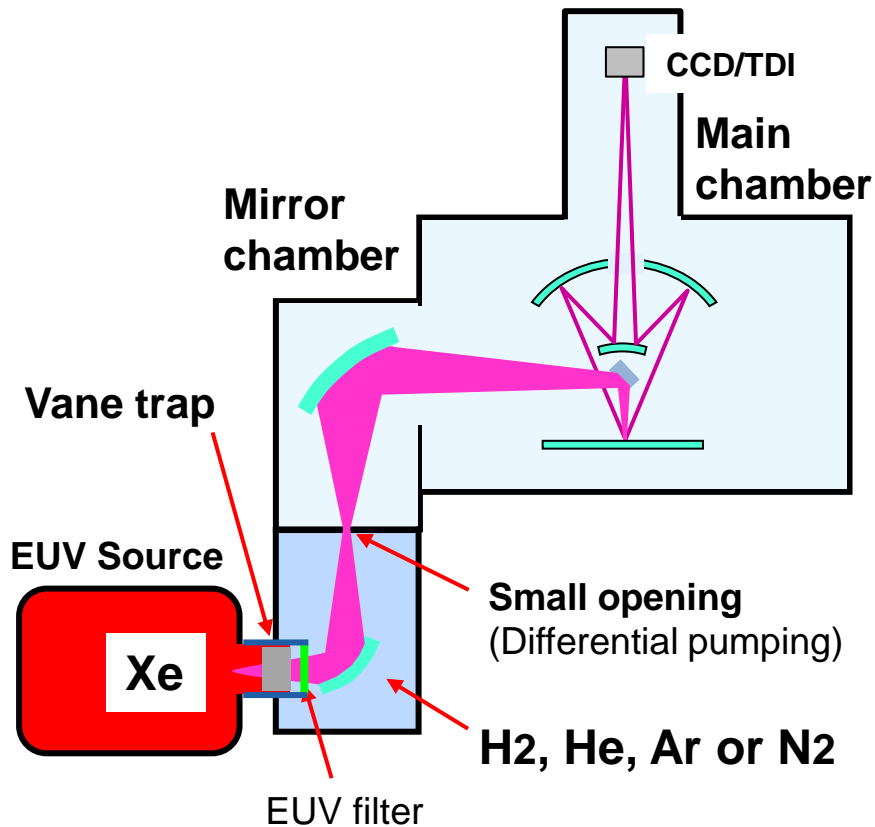
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Xe diffusion into the mirror chamber need to be suppressed



13.5nm radiation transmission in various gas

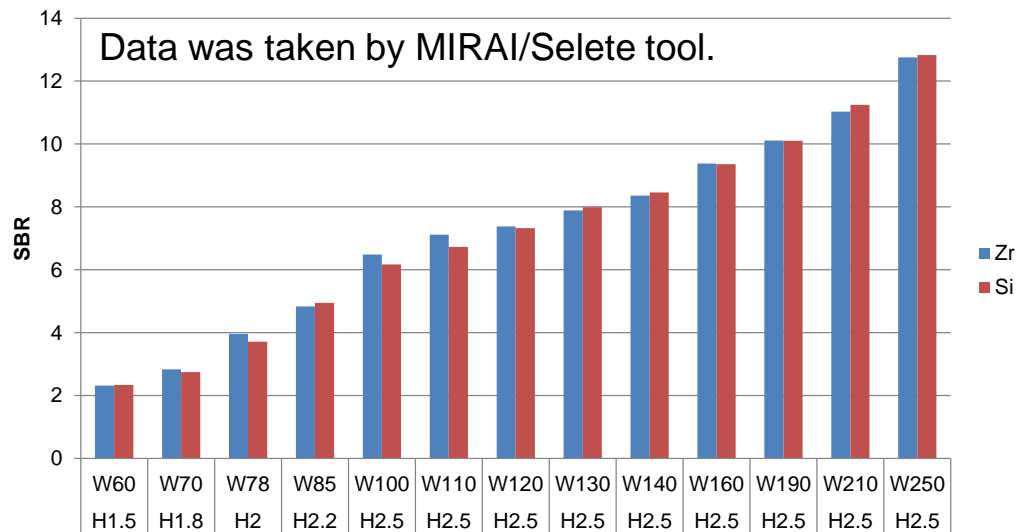
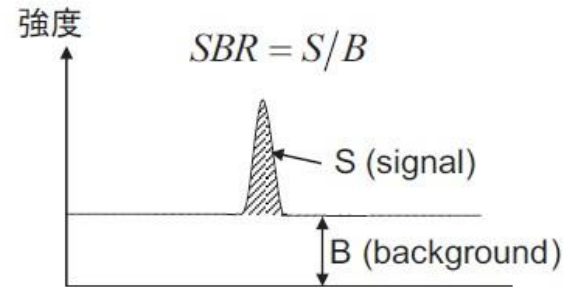
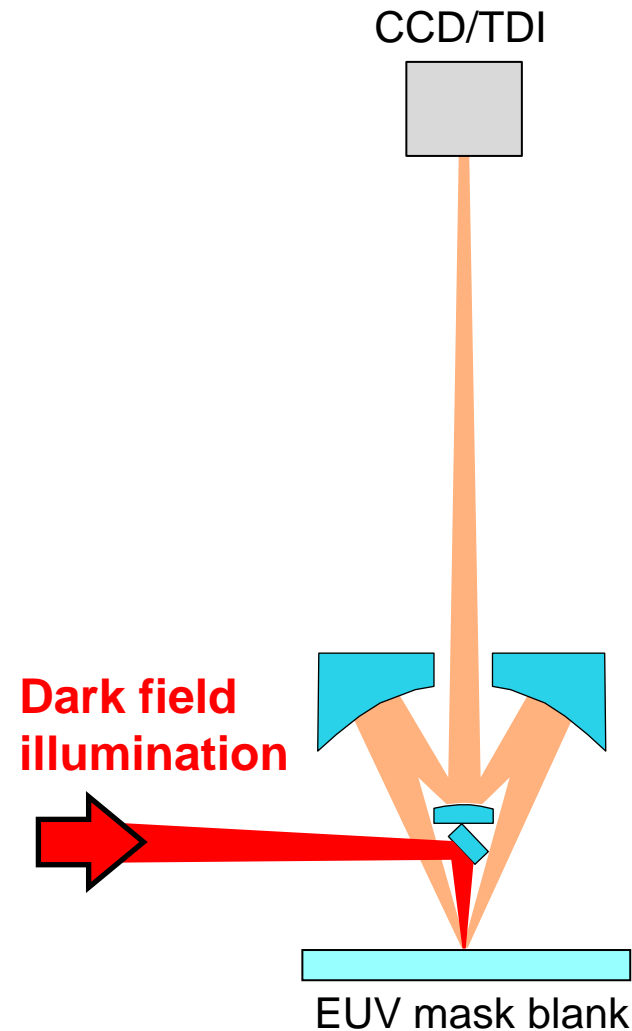
Xe diffusion into the mirror chamber can be stopped



Xe diffusion can be stopped in the vane trap by transparent gas

Out of band radiation does not affect sensitivity

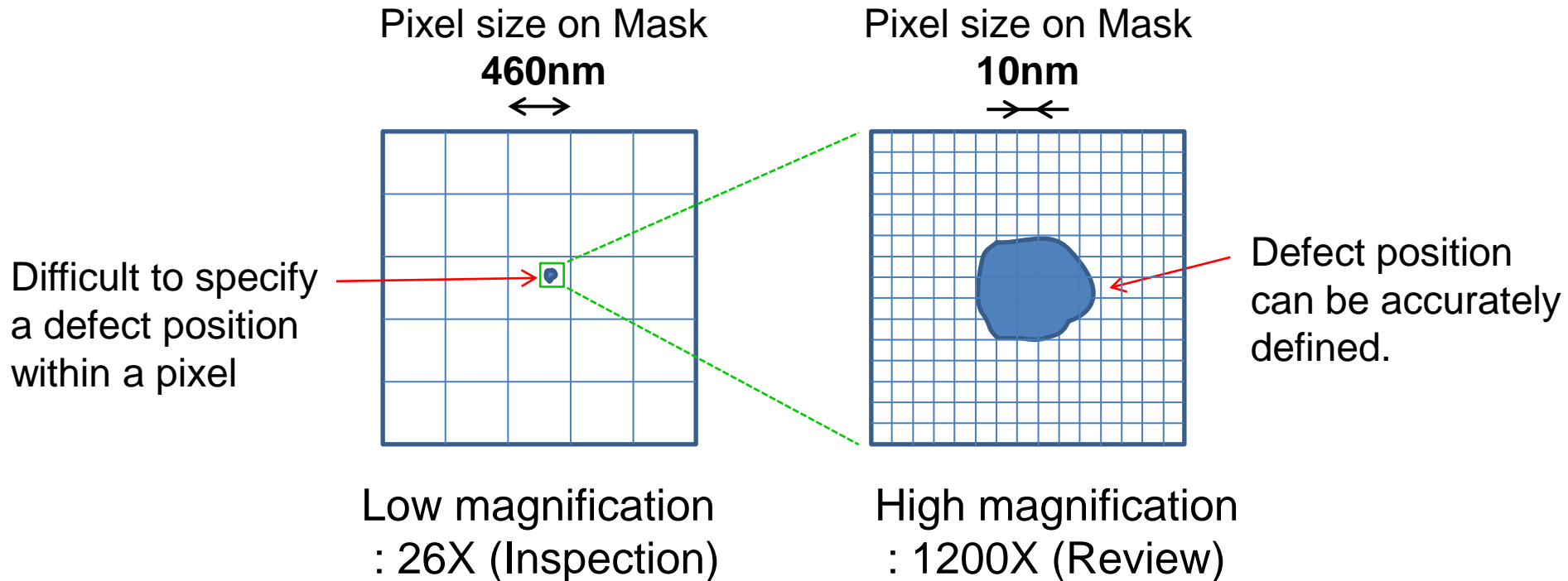
Sensitivity test using a Si filter which greatly transmits visible light.



Almost equal sensitivity was obtained between Zr and Si.

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Purpose of the high magnification review optics

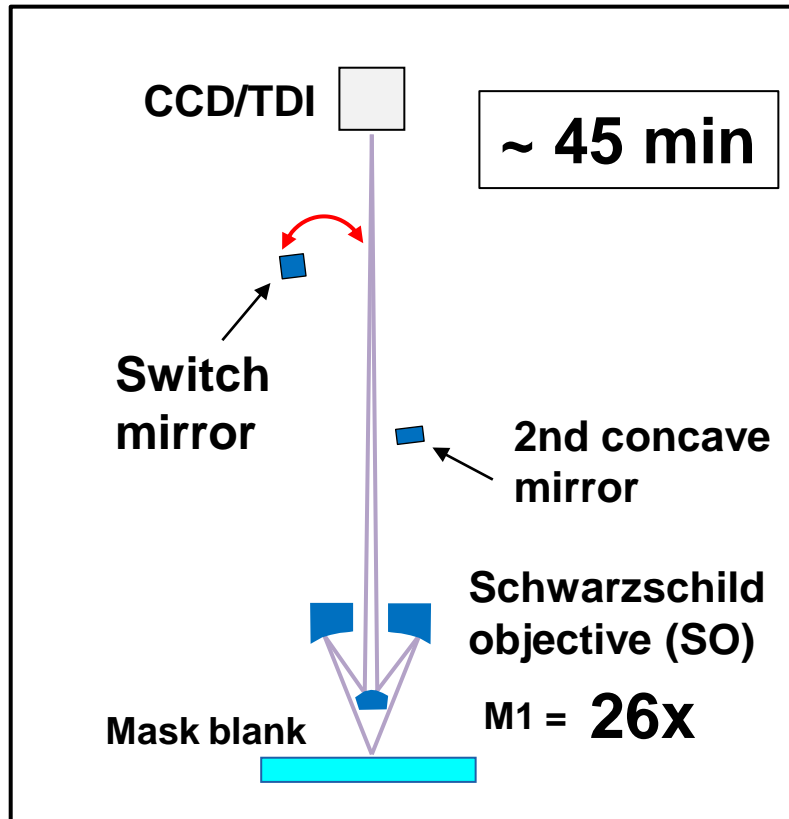


**1200X magnification review mode :
a basis for the accurate defect positioning**

Review mode integration

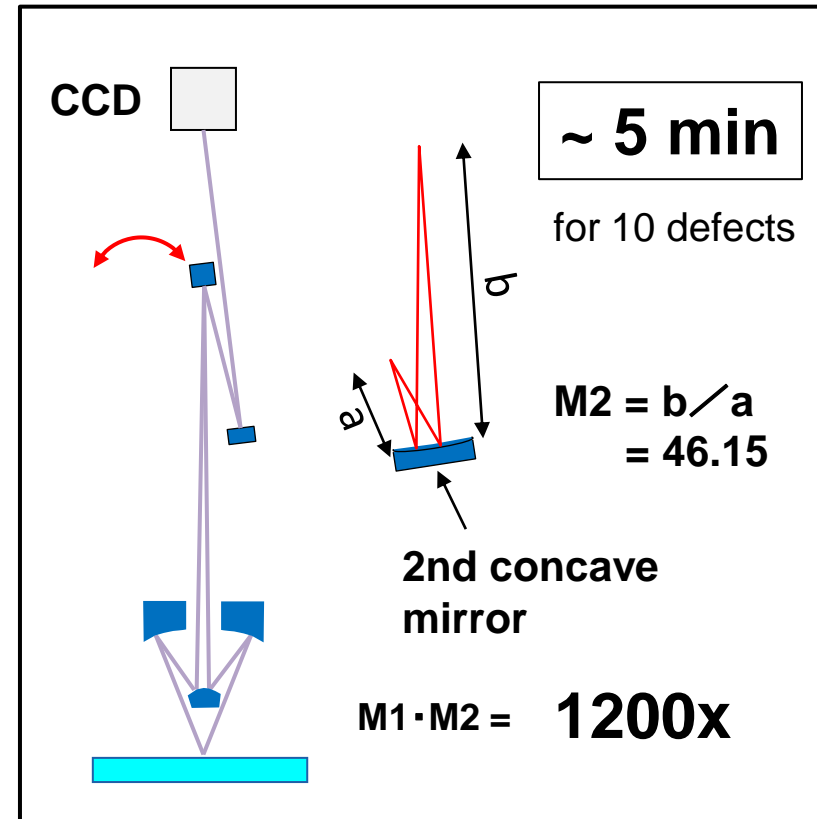
Inspection mode

(Mask whole area)



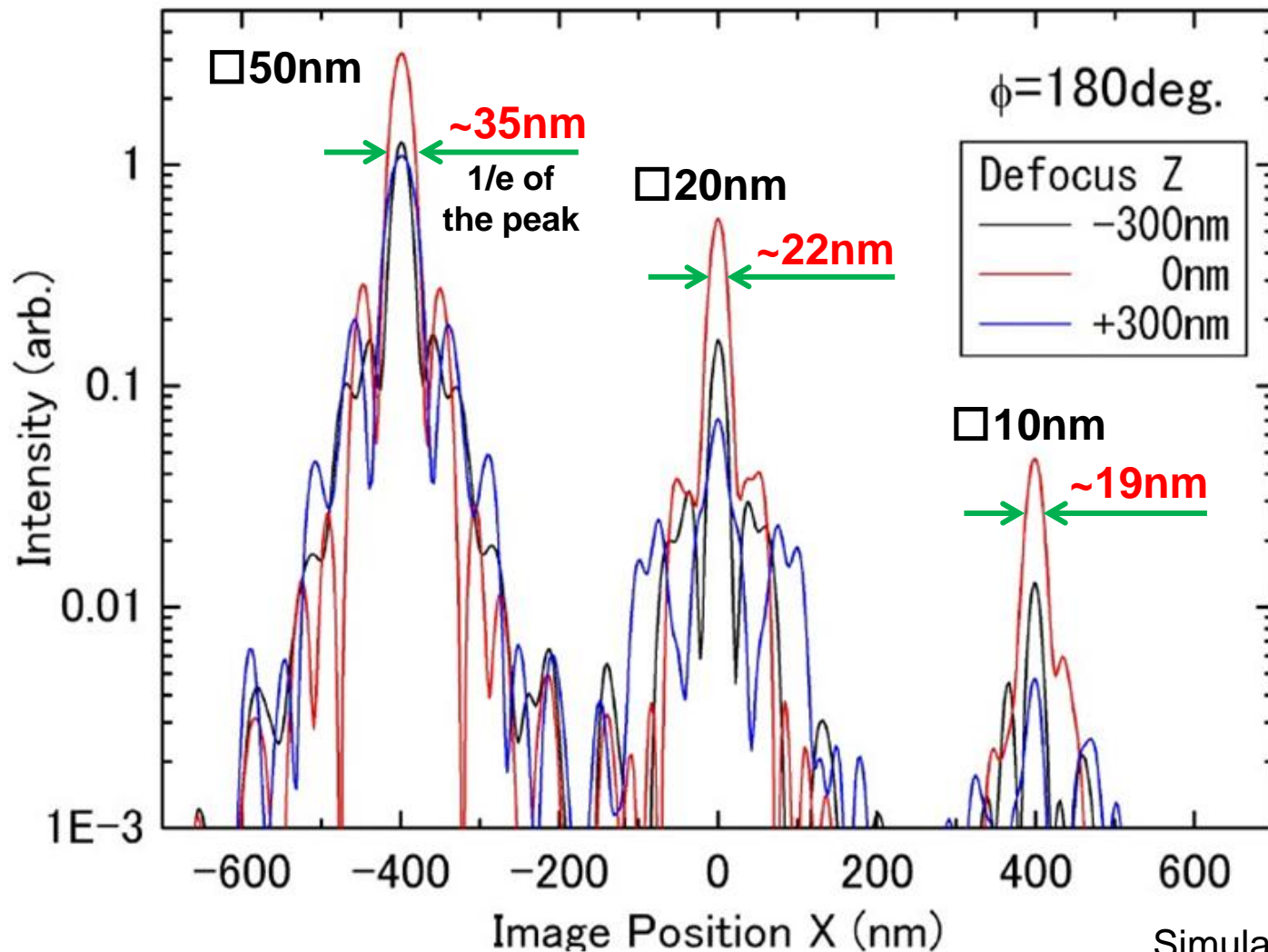
Review mode

(Area where defects are detected)



**High-Speed Inspection & High Resolution Review
implemented in one system**

Simulation results of the 1200X projection



$$\lambda=13.5\text{nm}$$
$$\text{NA}=0.27$$
$$k_1=0.25$$

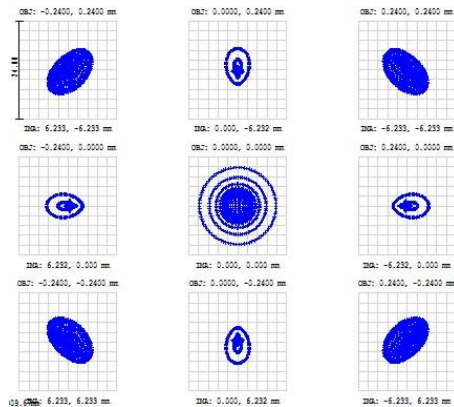
$$\text{Re} \sim k_1 \frac{\lambda}{\text{NA}}$$
$$= 12.5\text{nm}$$

Simulation results are given
by Dr. Toyoda of Tohoku Univ.

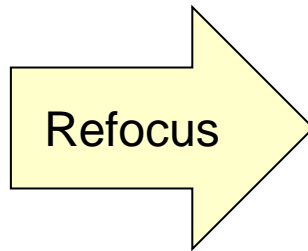
Small aberration can be obtained at the center

Spot diagrams in the 0.47x0.47mm area for the 26X SO

Inspection mode

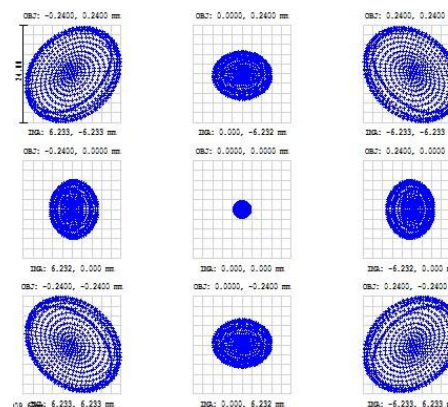


24um at TDI sensor

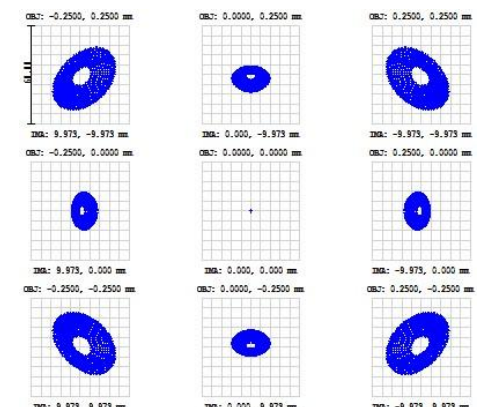


Review mode

Concave: Ellipsoidal



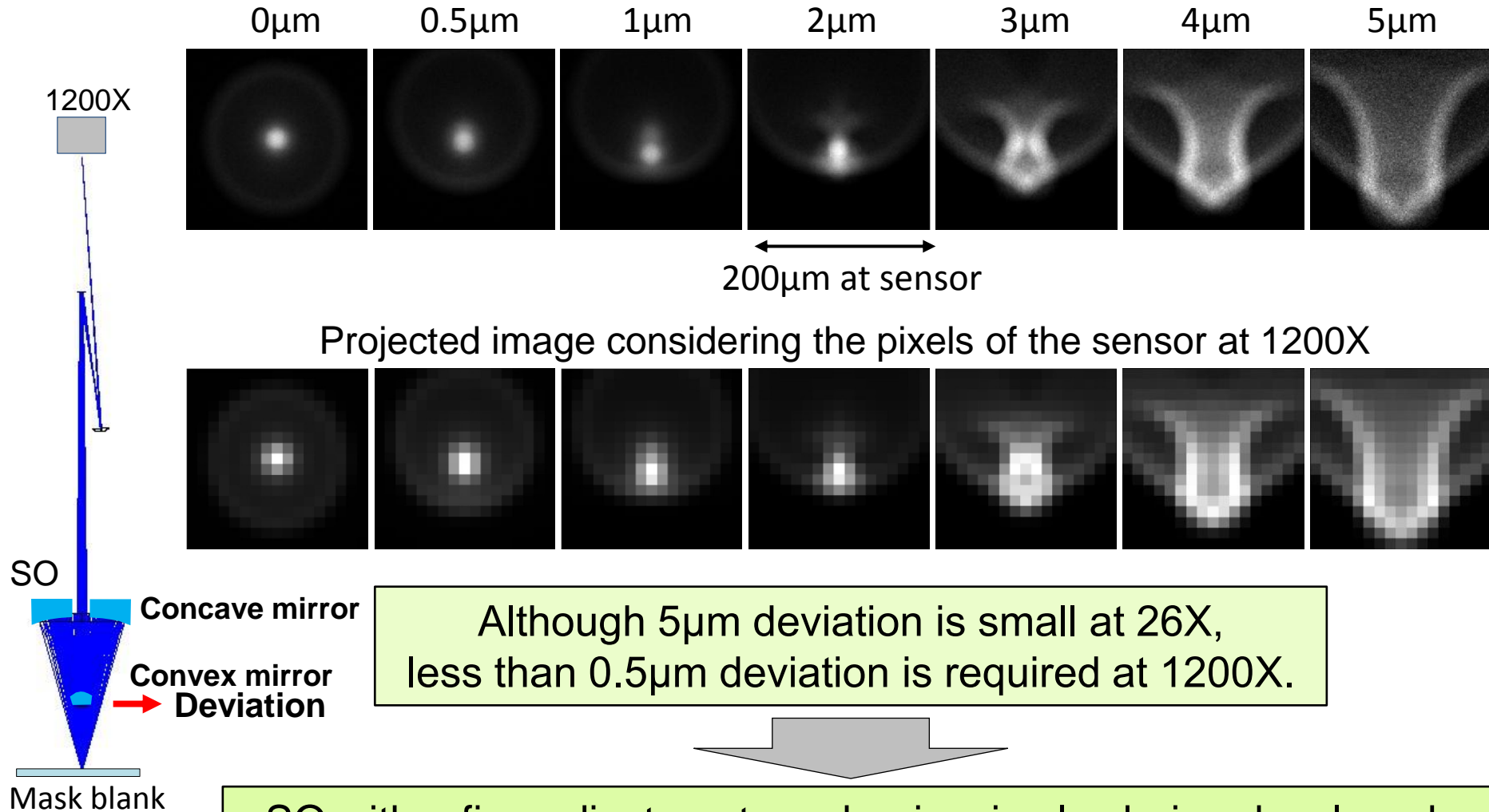
Concave: Aspherical



An improved SO using an aspherical concave mirror is also being developed.

Review image degradation by the imperfection of SO

Deviation of the coaxiality of the convex and the concave mirror



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Summary

1. ABI HVM tool has a target of < 45min inspection time by improving the illumination optics as well as EUV source.
2. In order to increase the illumination optics efficiency, a new EUV filter and a new vane trap are employed.
3. Xe diffusion can be suppressed by transparent gas. Also it has been demonstrated that the OoB radiation does not affect the inspection sensitivity.
4. 1200X magnification review optics are design based on the 26X SO. Also an improved SO is being developed.

Acknowledgement

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- Dr. Toyoda of Tohoku Univ.

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